SIMPLIFIED "T" INTERCHANGE DESIGN FOR A "T" INTERSECTION OF A FOUR LANE EXPRESSSWAY WITH A TWO LANE HIGHWAY

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SIMPLIFIED "T" INTERCHANGE DESIGNS FOR A "T" INTERSECTION OF A DIVIDED EXPRESSWAY OR FREEWAY WITH A TWO LANE HIGHWAY

This application claims priority to U.S. Provisional Application Number 60/427,868 filed on 11/19/2002 which for purposes of disclosure is incorporated herein by specific reference.

BACKGROUND OF THE INVENTION

Most people are familiar with the interstate freeway system in the United States. The four lane interstate highway system interconnects all of the states. The standard design of this interstate system provides safe divided highways with at least two lanes of traffic in opposite direction. Where the interstate system intersects two lane highways such as state highways or county highways, an over-pass bridge is always provided so that traffic never cuts in front of each other on the same level. Additionally, "off ramps" are always provided so that vehicles can safely make the transition off of the freeway and onto the intersecting highways. Also, "on ramps" are always provided so that vehicles can make the transition from the intersecting two lane highways onto the the freeway. The "on ramps" often provide a third lane for the "on ramp" that is long enough so vehicles entering the freeway can get up to freeway speed before they are required to merge into the fast lanes of freeway traffic.

This freeway design has proven to be very safe in general.

Accidents, if they occur are most of the time not very severe because the traffic is generally always going in the same direction. Many states also have built "in state" freeway systems. Many of these "in state" freeway systems follow the interstate design format where all intersecting highways have overpass bridges and on and off ramps for transitions.

Many states also have built instate "expressway" systems. An expressway system has a divided highway similar to the interstate freeway, however there is a big difference. An expressway system has a divided highway but all intersecting highways do not have overpass bridges and/or "on and off ramps" for transitions. Generally there are two types of expressway intersections; a "crossing" intersection and a "T" intersection.

Vehicles desiring to cut across a divided express way generally, must follow the following procedure: If a driver desires to cut across a divided expressway that person must stop at the intersection with traffic passing in front of him from left to right. When the driver feels it is safe, he must cut across the two lanes of expressway traffic and stop in the expressway median. The vehicle stopped in the median between the two traffic lanes of the expressway now has traffic passing in front of him from right to left. Vehicles making a left turn off of the expressway are making a left turn in front of the stopped vehicle in the median. Drivers

that are making a left turn off the freeway generally have the right of way. When the driver that is attempting the crossing thinks it is safe he then cuts across the two lanes of the expressway to complete the crossing.

Vehicles desiring to make a left turn from a two lane highway onto a divided express way generally, must follow the following procedure: that person must stop at the intersection with traffic passing in front of him from left to right. When the driver feels it is safe, he must cut across the two lanes of expressway traffic and stop in the expressway median. The driver then has the expressway traffic passing in front of him from right to left. Vehicles making a left turn off of the expressway onto the two lane highway are making a left turn in front of the stopped vehicle in the median. When the driver thinks it is safe he then makes a left turn onto the divided expressway. That left turn is made from the median and often there is no "on ramp" provided, so the vehicle must pull directly into the two lanes of the expressway, after stopping or slowing in the median.

These expressway systems have provided a improvement in moving traffic where they are built. However, there have been a lot of accidents at some of the intersections. The main cause of the accidents are because of the lack of overpass bridges and "on ramps and off ramps". Drivers coming off the two lane highways and into the crossing intersections have been pulling in front of expressway

vehicles when attempting to cross the expressway lanes. Also, vehicles at the "T" intersections have been pulling in front of expressway vehicles when attempting to cross the expressway lanes.

A lot of these expressways are built in somewhat rural areas and driveways from homes often connect directly the divided expressway.

To build an interchange at a crossing intersection or a "T" intersection, generally would cost between three to five million dollars or more per interchange(in 2003 U.S. Dollars). In general, the reason the interchanges are not built on expressways is because of the lower volume of traffic compared to other highway locations. Also, the highway departments spend what money they have on what they feel are the most important problems in their highway districts.

SUMMARY AND OBJECTS OF THE INVENTION

It is a primary object of the invention to provide simplified "T' interchange design for a "T" intersection of a divided expressway or freeway with a two lane highway.

It is another object of the invention to provide simplified "T' interchange design for a "T" intersection of a divided expressway or freeway with a two lane highway that would be very inexpensive to build when compared to the cost to build a conventional interchange. The simplified "T" interchange design could be built for approximately 20% to 25% of the cost of a traditional interstate interchange.

It is another object of the invention to provide simplified "T' interchange design for a "T" intersection of a divided expressway or freeway with a two lane highway that would not be confusing for vehicles passing through the interchange from any direction.

It is another object of the invention to provide simplified "T' interchange design for a "T" intersection of a divided expressway or freeway with a two lane highway that would be very

safe for vehicles passing through the interchange from any direction. Vehicles are never required to cut across lanes of high speed traffic when making transitions between the two lane highway and the expressway. Any vehicles passing in front of one another would at most be traveling at only a few miles an hour. Also "on ramps" and "off ramps" are provided so that vehicle making transitions a able to get up to speed before merging with high speed traffic.

It is another object of the invention to provide simplified "T' interchange design for a "T" intersection of a divided expressway or freeway with a two lane highway that would not be confusing for vehicles passing through the interchange from any direction even if the interchange is built on a curving expressway.

It is another object of the invention to provide simplified "T' interchange design for a "T" intersection of a divided expressway or freeway with a two lane highway that would use less space to build when compared to the cost to build a conventional interchange. This simplified design may only take up 20% to 25% of the space of a conventional expressway ro freeway interchange.

It is another object of the invention to provide a simplified "T' interchange design for a "T" intersection of a divided expressway or freeway with a two lane highway that would enable a an existing expressway "T" to be modified fairly inexpensively.

It is another object of the invention to provide simplified

"T' interchange design for a "T" intersection of a divided expressway or freeway with a two lane highway that would enable a an existing expressway "T" to be modified without having to purchase extra land for the highway right of way.

It is another object of the invention to provide simplified "T' interchange design for a "T" intersection of a divided expressway or freeway with a two lane highway that would require very little engineering design. The components of the interchange are standard designs that have been built dozens and dozens of times.

It is another object of the invention to provide simplified "T' interchange design for a "T" intersection of a divided expressway or freeway with a two lane highway that would allow a lot of vehicles to be backed at the interchange and not create a hazard to other lanes of traffic.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a aerial photo of an example of an existing "T" intersection of a four lane expressway with a two lane highway.

Figure 2 is a aerial photo of an example of a second existing "T" intersection of a four lane expressway with a two lane highway. This photo also shows a "crossing" intersection of a two lane highway with a four lane expressway.

Figure 2A is a aerial photo of an example of a third existing

"T" intersection of a four lane expressway with a two lane highway.

Figure 3 is a chart showing accident rates on 13 four lane expressway intersections with two lane highways in northern Wisconsin.

Figure 4 is a aerial photo of an example of an existing "T" interchange of a four lane expressway with a two lane highway.

Figure 4A is a aerial photo of an example of an existing "T" interchange of a four lane interstate highway with a two lane highway.

Figure 5 is a aerial photo of an example of an existing "crossing" interchange of a four lane expressway with a two lane highway.

Figure 6A is a aerial photo of an example of an existing four lane interstate freeway with off ramps that exit into the median which is in between the lanes of the freeway. The median is used for gas stations and restaurants.

Figure 6 is a aerial photo of an example of an existing four lane expressway with off ramps that exit into the median which is in between the lanes of the expressway.

Figure 7 is drawing showing a plan view of of an example of a existing "T" intersection of a four lane expressway with a two lane highway.

Figure 8 is drawing showing a plan view of of an example of a first improved design for "T" interchange of a four lane

expressway with a two lane highway.

Figure 9 is drawing showing a plan view of of a second example of a improved design for "T" interchange of a four lane expressway with a two lane highway.

Figure 10 is drawing showing a plan view of of a third example of a improved design for "T" interchange of a four lane expressway with a two lane highway.

Figure 11 is drawing showing an elevation view of a overpass or bridge that would be used in the improved designs for "T" interchange of a four lane expressway with a two lane highway shown herein.

Figure 12 is drawing showing an elevation view of an alternate design for an overpass or bridge that would be used in the improved designs for "T" interchange of a four lane expressway with a two lane highway shown shown herein.

Figure 13 is a aerial photo of an example of an existing "T" intersection of a four lane expressway with a two lane highway. The improved design for "T" interchange of a four lane expressway with a two lane highway is superimposed on the top of the existing intersection.

The objects and advantages of the invention will become apparent when the drawings are studied in conjunction with reading the following description and claims.

DESCRIPTION OF THE PRIOR ART EXPRESSWAY INTERSECTIONS

Many states have built instate "expressway" systems. An expressway system has divided traffic lanes similar to the interstate freeway, however there is a big difference. An expressway system has a divided highway lanes but all intersecting highways do not have overpass bridges and on and off ramps for transitions.

Figure 1 is a aerial photo of an example of an existing "T" intersection of a four lane expressway with a two lane highway. This "T" intersection is in Bayfield County Wisconsin is shown generally at 10. The two lane highway 12 is Wisconsin Highway 13 and the divided highway 14 is U.S. Highway 2. The two lane highway and the four lane highway connect form a "T" intersection 16. Divided highway 14 has a median 18 between the lanes of traffic. When a vehicle is traveling on the two lane highway 12 toward the divided expressway 14, that vehicle generally must stop before attempting any turns onto the expressway. Any traffic that passes in front of his vehicle is traveling in lanes 20 of the expressway from left to right, and these vehicles would be traveling between 55 to 70 miles per hour. When making a right turn onto the first two lanes 20 of the expressway the vehicle must pull into the first lane within a short distance. As can be seen in the aerial photo there is no "on ramp" for a vehicle to get up to speed before merging onto the expressway.

If a driver that is in two lane highway 12 desires to make a left turn onto lanes 24 of divided expressway, that person must stop at the intersection. Any traffic passing in front of him in lanes 20 the expressway would be traveling from left to right and these vehicles would be traveling between 55 to 70 miles per hour. When the driver feels it is safe, he must cut across the two lanes of high speed expressway traffic and stop or slow down in the expressway paved median 22. The vehicle stopped in the median 22 between the two expressway traffic lanes of the expressway now has traffic passing in front of him from right to left in lanes 24 of expressway traffic. These expressway vehicles would be traveling between 55 to 70 miles per hour. Vehicles making a left turn off of the two lanes 24 of the expressway are making a left turn in front of the stopped vehicle in the median 22.

To complete left turn onto the divided expressway, when the driver thinks it is safe, he then pulls onto the divided expressway. the vehicle generally must pull directly into the two lanes 24 of the expressway, after stopping in the median. That left turn is made from the median and often there is no third lane for an "on ramp" provided so that the vehicle can get up to speed before merging with the high speed expressway traffic in lanes 24. As can be seen in the figure 1 aerial photo there is no "on ramp" for a vehicle to get up to speed before merging onto the expressway when making a left turn onto the expressway. There is some paint on

the pavement that supposedly directs through traffic in lanes 24 of the freeway to get into the right lane. Many through drivers do not get into the right lane. Additionally, when snow covers the pavement the paint on the highway is covered and through drivers then have no instructions to get in the right lane of lanes 24.

Vehicles making a right turn off the expressway lanes 20 onto the two lane highway 12 have an "off ramp" 26 however the small radius has proven to make the ramp slippery when the pavement is wet from snow or rain.

As can be seen in the photo the expressway is built on a long a curvature where it intersects with the two lane highway. Drivers have complained that it is very difficult to determine which lanes the expressway vehicles are in as they approach the intersection in lanes 20 of the expressway. As expressway vehicles in lanes 20 approach the intersection, it is difficult to determine whether they are intending to turn right onto the two lane highway or whether they are intending to pass directly through the intersection. This intersection is rather compact and is built on wetlands. Area 28 is substantially a lake and area 30 and area 32 are wetlands.

Figure 2 is a aerial photo of an example of another existing "T" intersection of a four lane expressway with a two lane highway shown generally at 35. This "T" intersection is in Douglas County Wisconsin. The two lane highway 36 is Wisconsin Highway 253 and the

divided highway 38 is U.S. Highway 53. The two lane highway and the four lane highway connect form a "T" intersection 40. Divided highway 42 has a paved median 44 between the lanes of traffic. When a vehicle is traveling on the two lane highway 36 toward the divided expressway 46, that vehicle generally must stop before attempting any turns onto the expressway. Any traffic that passes in front of his vehicle is traveling from left to right. When making a right turn onto the first two lanes 46 of the expressway the vehicle must pull into the first lane within a short distance. As can be seen in the aerial photo there is no "on ramp" for a vehicle to get up to speed before merging onto the expressway lanes.

If a driver desires to make a left turn onto a divided expressway that person must stop at the intersection. Any traffic passing in front of him would be passing from left to right. When the driver feels it is safe, he must cut across the first two lanes 46 of expressway traffic and stop or slow down in the expressway paved median 48. The vehicle stopped in the median 48 between the two traffic lanes of the expressway now has any traffic passing in front of him from right to left in the next two lanes 50 of the expressway. Vehicles making a left turn off of the expressway are making a left turn in front of the stopped vehicle in the paved median 48.

To complete left turn onto the divided expressway, when driver

thinks it is safe, he then pulls left onto the lanes 50 of the divided expressway. The vehicle generally must pull directly into the second two lanes 50 of the expressway, after stopping in the paved median 48. That left turn is made from the median and often there is no third lane for an "on ramp" provided so that the vehicle can get up to speed before merging with the high speed expressway traffic. As can be seen in the figure 2 aerial photo there is no "on ramp" for a vehicle to get up to speed before merging onto the expressway when making a left turn onto the expressway.

Vehicles making a right turn off the expressway lanes 46 onto the two lane highway 36 do not have an "off ramp".

As can be seen in the photo the expressway has a long curvature where it intersects with the two lane highway. This curvature would make it very difficult to determine which lanes the vehicles are in as they approach the intersection from either direction. As the expressway vehicles approach the intersection, it is difficult for drivers stopped on the two lane stop sign to determine whether expressway drivers are intending to turn right onto the two lane highway or whether they are intending to pass directly through the intersection.

Figure 2 also shows a "crossing intersection" of an expressway generally at 54. This type of expressway intersection has also been problematic and there have been numerous accidents at this type of

intersection. Most of the accidents have occurred when a driver is attempting a crossing from a two lane highway. The drivers have made it safely through the first two lanes of the expressway and then have pulled into traffic in the second two lanes. The accidents have tended to be very serious as the impact is at a high rate of speed.

Figure 2A is a aerial photo of an example of another existing "T" intersection of a four lane expressway with a two lane highway. This "T" intersection is in northern Minnesota.

Figure 3 is a chart showing accident rates on 13 expressway intersections in northern Wisconsin. The crash rates are reported as number of crashes per 1,000,000 vehicles entering the intersection. Of the thirteen intersections, five are "T" intersections and the seven are "crossing" intersections.

Figure 4 is a aerial photo of an example of an existing "T" interchange shown generally at 57 of a four lane expressway with a two lane highway. This interchange is built in Iron County Wisconsin where Highway U.S. 2 intersects Wisconsin Highway 51. The interchange includes a divided four lane expressway 58 which passes under a bridge or overpass 60. The bridge 60 enables the two lane highway 62 to pass over all four lanes of the divided expressway 58. Transition ramp 64 enables vehicles exiting the expressway side 66 to make a smooth transition through the "T" interchange when making a right turn onto the two lane highway 62.

Transition ramp 68 enables vehicles exiting the expressway to make a smooth transition through the "T" interchange when making a right turn off of expressway side 70 onto the two lane highway 62.

Transition ramp 72 enables vehicles exiting the two lane highway 62 to make a smooth transition through the "T" interchange when making a right turn onto the expressway side 66.

Transition ramp 74 enables vehicles exiting the two lane highway 62 to make a smooth transition through the "T" interchange when making a left turn onto the expressway side 70.

This interchange design has proven to be very safe. As can be seen there is no cutting across traffic as vehicles make transitions in all directions. There are no stop sign that require vehicles to stop when making transitions in all directions. It was built in 1961 and in over 40 years of use there is no record of any accident ever taking place at the interchange. This interchange takes up a large amount of space. The interchange distance along the divided expressway is more than 3500 feet would be approximately 1000 feet wide. This interchange cost between 3 to 4 million dollars to build.

Figure 4A is a aerial photo of an example of an existing "T" interchange shown generally at 57 of a four lane interstate highway with a two lane highway. This interchange is built in Wisconsin where Highway U.S. 2 intersects Interstate Highway 90. Note that two short bridges are used on the interstate lanes and the two lane

highway passes under the bridges and the interstate lanes.

Figure 5 is a aerial photo of an example of an existing "crossing" interchange shown generally at 77 of a four lane expressway or freeway with a two lane highway. This interchange is built in Douglas county Wisconsin is similar to interstate freeway design. The divided expressway 78 is U.S. Highway 2 and the two lane highway 79 is Wisconsin Highway 13.

The interchange includes a divided four lane expressway 78 which passes under a bridge or overpass 80. The bridge 80, which is approximately 600 feet long, enables the two lane highway 79 to pass over all four lanes of the divided expressway 78. Transition ramp 81, which is approximately 800 feet long, enables vehicles exiting the expressway side 82 to make a smooth transition off the divided interchange when making an exit onto the two lane highway 79. Vehicles are required to stop at a stop sign 83 where transition ramp 80 meet two lane highway 79.

Transition ramp 84, which is approximately 800 feet long, enables vehicles exiting the expressway side 85 to make a smooth transition off the divided interchange when making an exit onto the two lane highway 79. Vehicles are required to stop at a stop sign 83 where transition ramp 84 meet two lane highway 79.

Transition ramp 86, which is approximately 1000 feet long, enables vehicles exiting the two lane highway 79 to make a smooth transition when making a right turn off of the two lane highway 79

onto the expressway side 82. Vehicles using transition ramp 86 are not required to stop as they engage expressway 82. Transition ramp 86 forms a third lane that enables vehicles to get up to speed before they are required to merge into the two lanes 82 of the expressway.

Transition ramp 87, which is approximately 1000 feet long, enables vehicles exiting the two lane highway 79 to make a smooth transition when making a right turn off of the two lane highway 80 onto the expressway side 85. Vehicles using transition ramp 87 are not required to stop as they engage expressway lanes 85. Transition ramp 87 forms a third lane that enables vehicles to get up to speed before they are required to merge into the two lanes 85 of the expressway.

This interchange design has proven to be a very safe design. This interchange design takes up a large amount of space. The interchange is approximately 3000 feet long and has a width of approximately 1000 feet. The expressway median has approximately a distance of 200 feet between the opposite lanes of traffic. It cost between 3 to 4 million dollars to build.

Figure 6 is a aerial photo of an example of an existing four lane expressway 89 with two traffic lanes 90 going in one direction and two additional traffic lanes 91 going in the opposite direction. Off ramps 92, which are approximately 400 feet long, enable vehicles to make an exit into the median 93 which is located

between the opposite lanes of the expressway. "On ramps" 94, which are approximately 600 feet long, enable vehicles to make a smooth transition from the median 93 back onto the expressway without stopping. The on ramp provides a third lane so that vehicles can get up to speed before merging with the expressway traffic. Additional ramps 96 and parking space 97 are also provided in the median. This facility a weigh station for trucks and semi-trailers. It is located in Douglas County Wisconsin on Highway U.S. 2. The speed limit on the expressway is 65 miles per hour. The ramp designs are such that these trucks are able use the "off ramps" to make an exit into the median to get weighed and then use the "on ramps" to get back on the expressway very easily and safely. This design takes up a large amount of space. The area is approximately 2500 feet long and has a width of approximately 600 feet. The median has approximately a distance of 400 feet between the opposite lanes of traffic.

Figure 6A is a aerial photo of an example of an existing four lane interstate highway in Indiana and Illinois. Vehicles exit into the median for fuel and for use of the restaurant.

Figure 7 is drawing showing a plan view of of an example of typical existing "T" intersection of a four lane expressway with a two lane highway. The two lane highway 98 and the four lane expressway 100 connect form a "T" intersection generally at 102. Divided expressway 100 has a median 104 between the lanes of

traffic. When a vehicle is traveling on the two lane highway 98 toward the divided expressway 100, that vehicle generally must stop before attempting any turns onto the expressway. Any traffic that passes in front of his vehicle is traveling from left to right. In lanes 106. When making a right turn onto the first two lanes 106 of the expressway the vehicle must pull into the first lane of lanes 106 within a short distance. Often there is no "on ramp" for a vehicle to get up to speed before merging onto the expressway.

If a vehicle desires to make a left turn onto a divided expressway that person must stop at the intersection. Any traffic passing in front of him again would be from left to right in lanes 106. When the driver feels it is safe, he must cut across the two lanes of expressway traffic 106 and stop or slow in the paved expressway median 108. The vehicle stopped in the paved median 108 between the two traffic lanes of the expressway now has any traffic passing in front of him from right to left in expressway lanes 110. Vehicles making a left turn off of the expressway lanes 110 are making a left turn in front of the stopped vehicle in the median 108.

To complete left turn onto lanes 110 of the divided expressway, when driver thinks it is safe, he then pulls onto the divided expressway lanes 110. The vehicle generally should pull directly into the first of two lanes 110 of the expressway, after stopping in the median. That left turn is made from the median 108 and often

there is no third lane for an "on ramp" provided so that the vehicle can get up to speed before merging with the high speed expressway traffic.

Vehicles making a right turn off the expressway lanes 106 onto the two lane highway 98 have an "off ramp" 112. This as well as other drawings herein are not to scale. Their purpose is to aid the explanation of the inventive concepts described herein.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 8 is drawing showing a plan view of of first example of a improved design for "T" interchange of a divided expressway with a two lane highway. The two lane highway 98 and the four lane expressway 100 connect form a "T" interchange generally at 115. Divided expressway 100 has a median 122 between the lanes of traffic. When a vehicle is traveling on the two lane highway 98 toward the divided expressway 100, that vehicle passes up ramp 124 and over bridge 126 and stops in front of stop sign 128. After stopping , vehicle would then make a left turn, travel down ramp 130 and proceed onto merging ramp 132 and eventually merge into expressway lanes 110.

Vehicles desiring to make a right turn off of two lane highway 98 onto the first two lanes 106 of the expressway use ramp 138. A merging lane enables vehicles to get up to speed before merging

onto the expressway lanes 106.

Vehicles making a right turn off the expressway lanes 106 onto the two lane highway 98 have an "off ramp" 140.

Vehicles traveling in a direction left to right on expressway lanes 106 that intend to travel through the interchange without turning travel under bridge 126.

If a driver that is traveling in divided expressway lanes 110 from right to left wants to make a left turn onto two lane highway 98, the driver first takes "off ramp" 140. That vehicle then passes up ramp 142 and stops at stop sign 144. After stopping, the vehicle then turns left and passes over bridge 126 and then down ramp 124 and continues on two lane highway 98.

Figure 9 is drawing showing a plan view of of a second example of a improved design for "T" interchange of a four lane expressway with a two lane highway. The two lane highway 98 and the four lane expressway 100 connect form a "T" interchange shown generally at 150. Divided expressway 100 has a median 151 between the lanes of traffic. If a driver wants to take a left turn onto the expressway, he travels on the two lane highway 98 toward the divided expressway 100. That vehicle then passes over bridge 152 stops in front of stop sign 154. After stopping , vehicle would then make a left turn, proceed onto merging ramp 156 and eventually merge into expressway lanes 110.

Vehicles desiring to make a right turn off of two lane highway

98 onto the first two lanes 106 of the expressway use ramp 158. A merging lane enables vehicles to get up to speed before merging onto the expressway lanes 106.

Vehicles making a right turn off the expressway lanes 106 onto the two lane highway 98 have an "off ramp" 159.

Vehicles traveling in a direction left to right on expressway lanes 106 that intend to travel through the interchange without turning, travel under bridge 152.

If a vehicle that is traveling in a right to left direction on divided expressway 110 wants to make a left turn onto two lane highway 98, the driver first takes off ramp 160. That vehicle then stops at stop sign 162. After stopping, the vehicle then turns left and passes over bridge 152 and continues on two lane highway 98. This design is similar to the interchange design shown in figure 8. The difference is that expressway lanes 106 are built at a lower level than the rest of the interchange and essentially "tunnels" under bridge 152. This design eliminates the ramps 124, 130 and 142 that are shown in figure 8. The design shown in fig 9 would be a lot less expensive to build if the location would permit.

Figure 10 is drawing showing a plan view of of a third example of a improved design for "T" interchange of a divided expressway with a two lane highway. The two lane highway 98 and the four lane expressway 100 connect form a "T" interchange generally at 170. Divided expressway 100 has a median 172 between the lanes of

traffic. When a vehicle is traveling on the two lane highway 98 toward the divided expressway 100, that vehicle passes under bridge 174 and stops in front of stop sign 176. After stopping , vehicle would then make a left turn, proceed onto merging ramp 178 and eventually merge into expressway lanes 110.

Vehicles desiring to make a right turn off of two lane highway 98 onto the first two lanes 106 of the expressway use ramp 180. A merging lane enables vehicles to get up to speed before merging onto the expressway 106.

Vehicles making a right turn off the expressway lanes 106 onto the two lane highway 98 have an "off ramp" 182.

Vehicles traveling in a direction left to right on expressway lanes 106 that intend to travel through the interchange without turning travel up ramp 173, over bridge 174, down ramp 175 and continue on lanes 106.

If a vehicle that is traveling in a right to left direction on divided expressway lanes 110 wants to make a left turn onto two lane highway 98, the driver first takes off ramp 184. That vehicle then stops at stop sign 186. After stopping, the vehicle then turns left and passes under bridge 174 and continues on two lane highway 98.

Some additional features that could be incorporated into the interchange include a safety fence 188 on both sides ramp 173 and ramp 175. Another feature would be a fence or barrier 189 in the

median 172 between lanes 110 and the end of highway 98. This would prevent traffic from getting into lanes 110 without using on ramp 178. The design shown in FIG 9 could be incorporated where there is a difference in elevation between the two expressway lanes through a hilly area, for example. Lanes 106 may be 15 to 20 feet lower than lanes 110.

Figure 11 is a drawing showing an elevation view of the overpass or bridge and ramps that would be used in the improved designs for "T" interchange of a four lane expressway with a two lane highway shown in figures 8,9, 10 and 13. This version corresponds to the design shown in Fig.10 and Fig. 13.

Generally at 196 is a typical bridge or over pass that could be built over a two lane highway 98. Bridges typically have a top deck and side rail 200. Support pillars 202 extend from ground level 204 and up to the bridge deck 200. In Wisconsin the clearance for bridges is approximately 17 feet as of November 2002. For a two lane highway the width between the pillars would be approximately 84 feet. The bridge deck would be approx 146 feet long by 44 feet wide if the bridge deck is for a two lane highway passing over it. This would be a 6424 square foot bridge. Ramps 173 and 175 that are 600 feet long would be needed for vehicles to pass over the top. Fill 205 would have to be placed under the ramps during construction.

Figure 12 is a drawing showing an elevation view of an overpass or bridge that would be used in the improved designs for "T" interchange of a four lane expressway with a two lane highway shown herein. This version corresponds to the design shown in Fig.9.

Generally at 205 is a typical bridge or over pass that could be built over a two lane highway 98 built at level 208. Bridges typically have a top deck and side rail 200. Support pillars 202 extend from ground level 208 and up to the bridge deck 200. In Wisconsin the clearance for bridges is approximately 17 feet as of November 2002. For a two lane highway the width between the pillars would be approximately 84 feet. The bridge deck would be approx 146 feet long by 44 feet wide if the bridge deck is for a two lane highway 210 passing over it at level 211. This would be a 6424 square foot bridge. Ramps would not be needed for vehicles to pass over the bridge top. Some type of ramp would be needed for roadway 98 to merge into roadway 210 at an appropriate location.

Figure 13 is a aerial photo of the expressway intersection shown in Fig. 1. The improved interchange design that is shown in fig. 10 is superimposed over the photo.

The two lane highway 98 and the four lane expressway 100 connect form a "T" interchange 170. Divided expressway 100 has a median 172 between the lanes of traffic. When a vehicle is traveling on the two lane highway 98 toward the divided expressway 100, that vehicle passes under bridge 174 and stops in front of

stop sign 176. After stopping , vehicle would then make a left turn, proceed onto merging ramp 178 and eventually merge into expressway lanes 110.

Vehicles desiring to make a right turn off of two lane highway 98 onto the first two lanes 106 of the expressway use ramp 180. A merging lane enables vehicles to get up to speed before merging onto the expressway 106.

Vehicles making a right turn off the expressway lanes 106 onto the two lane highway 98 have an "off ramp" 182.

Vehicles traveling in a direction right to left on expressway lanes 106 that intend to travel through the interchange without turning travel up ramp 173, over bridge 174, down ramp 175 and continue on lanes 106.

If a vehicle that is traveling in a right to left direction on divided expressway 110 wants to make a left turn onto two lane highway 98, first takes off ramp 184. That vehicle then stops at stop sign 186. After stopping, the vehicle then turns left and passes under bridge 176 and continues on two lane highway 98.

Some additional features that could be incorporated into the interchange include a safety fence 188 on both sides ramp 173 and ramp 175. Another feature would be a fence or barrier 189 in the median 172 between lanes 110 and the end of highway 98. This would prevent traffic from getting into lanes 110 without using on ramp 178. Of course if the interchange were designed from scratch a wide

median, perhaps 150 to 200 feet wide, could be incorporated therein enabling a lot of room for "on and off" ramps and contoured landscaping for the entire interchange.

As can be seen from the aerial photos and drawings many different designs could be incorporated into the various components of a new "T" interchange. No two locations would be exactly the same. Different designs of "on and off" ramps could be utilized as well as different designs for bridges. A long arched bridge made brownstone could be used in Bayfield County, Wisconsin where there is a lot of native brownstone. Different widths of medians as well as different landscaping and different trees or flowers, etc could be incorporated into the interchange locations.

There are numerous benefits that are provided by the proposed "simplified "T' interchange design." In general, all the hazardous aspects of the existing expressway "T" intersections would be eliminated. The results would be the elimination of all future serious and fatal accidents. The existing "T" intersection design has resulted in numerous accidents including several fatalities.

The new "T" interchange design would be very safe for vehicles passing through the new interchange from any direction. Vehicles are never required to cut across lanes of high speed traffic when making transitions between the two lane highway and the four lane expressway. Any vehicles passing in front of one

another would at most be traveling at only a few miles an hour.

Also "on ramps" and "off ramps" are provided so that vehicle making transitions a able to get up to speed before merging with high speed traffic.

The new simplified interchange design not be confusing for vehicles passing through the interchange from any direction even if the interchange is built on a curving expressway. This is one of the hazardous aspects the existing U.S. Hwy 2 and WI Hwy. 13 intersection. The four lanes of Hwy. U.S. 2 are built on a curve where the divided lanes intersect Hwy. WI 13.

Also, new "T" interchange design would allow a lot of vehicles to be backed up at the interchange and not create a hazard to other lanes of traffic. This is a another hazardous aspect of the existing "T' Intersection. If a Semi-trailer desires to make a left turn onto U.S. 2 from WI 13, there in not enough space in the existing median for the stopped trailer without blocking the other two lanes of U.S. 2.

The interchange would very inexpensive to build when compared to the cost to build a conventional interchange. The simplified design for a "T" interchange built for approximately 20% to 25% of the cost of a traditional interstate interchange. If the new proposed "T" design was included at the time the existing intersection were built, the components would have only added approximately $600,000.00 to the construction costs. Conventional

interchanges cost between 3 - 4 million dollars to build.

The simplified "T" interchange design takes less space to build when compared to the cost to build a conventional interchange. This simplified design may only take up 20% to 25% of the space of a conventional expressway freeway interchange. Also, the simplified "T' interchange design would enable a an existing expressway "T" intersections to be modified fairly inexpensively, and without having to purchase extra land for the highway right of way.

The new simplified "T" interchange design would require very little engineering design. The components of the interchange are standard designs that have been built dozens and dozens of times.

There are some general guidelines as to how much various components of highway construction cost. As of 2002 the following are projected costs in northern Wisconsin:

Interchanges: 3-4 million dollars

Bridges over water: $65 per square foot.

Bridges not over water: $55 per square foot.

Single box cell: $850 per lineal foot.

Double box cell: $1200 per lineal foot.

Build new two lane highway: $1,000,000.00 per mile

Build new four lane highway: $1,500,000.00 per mile

Resurfacing:overlays less than 2.5 inches $150,000.00/ mile

Reconstruction: Replacement of pavement, new curb & gutter,

minor grading --- $200,000 to $300,000 per mile

Reconstruction, Grading: All new base, new curb and gutter, vertical and horizontal change, new template $3500,000 to $750,000 per mile

This invention having been described in its presently contemplated best mode, it is clear that it is susceptible to numerous, variations, modifications, modes and embodiments within the ability of those skilled in the art and without departing from the true spirit and scope of the novel concepts or principles of this invention.